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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/880,733

06/12/2001

Tasao Soga

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20350

7590

09/22/2004

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EXAMINER

ANDUJAR, LEONARDO

ART UNIT

PAPER NUMBER

2826

DATE MAILED: 09/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/880,733

Applicant(s)

SOGA ET AL.

Examiner

Leonardo Andújar

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 06/28/2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 27-37 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 27,28,30-32 and 34-36 is/are rejected.
- 7) ☒ Claim(s) 29,33 and 37 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date: _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date: _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 06/28/2004 has been entered.

Priority

2. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a

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later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 27, 28, 30, 31, 34 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koning (US 6,365,973 cited by applicant) in view of lino et al. (US 6,207, 259).

6. Regarding claims 27 and 34, Koning (e.g. figs. 1 and 2) shows an electronic device comprising a semiconductor device 104 provided with pads 108 and a substrate 106 provided with pads 114 on which the semiconductor device is mounted. Also, Koning shows that the semiconductor device's pads and the substrate's pads are bonded by junctions 102. The junctions include Cu balls 124 that are bonded to each other by Cu-Sn compounds 116 (col. 3/lls. 31-47). Furthermore, Koning discloses that the ball 124 may also be formed of a Cu-Sn alloy. As shown in figure 2, the Cu-Sn bonding material is formed at the peripheries of the Cu balls.

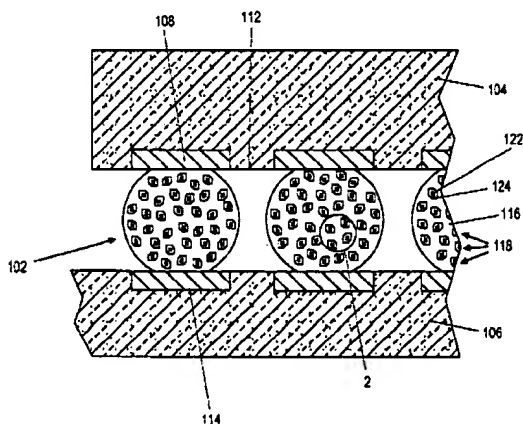


FIG. 1

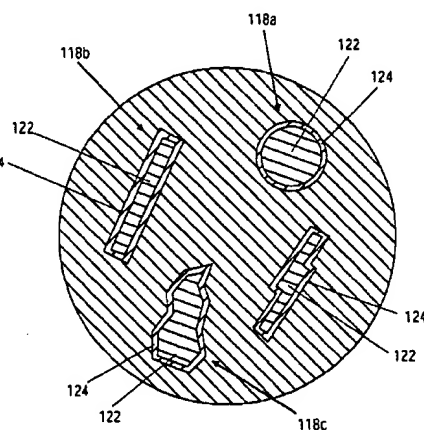


FIG. 2

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Although Koning does not list all possible Cu/Sn intermetallic compounds it is a scientific fact that Cu/Sn intermetallic compounds include Cu_3Sn_6 and/ or Cu_6Sn_5 . For example, lino teaches that Cu_3Sn_6 and $\text{Cu}_6\text{Sn}_5\text{C}$ are Cu/Sn intermetallic compounds. According to lino a $\text{Cu}_6\text{Sn}_5/\text{Cu}_3\text{Sn}_6$ ratio of less than 0.65 improves the electric and heat resistance properties of the alloy (col. 3/ll. 63-col. 4/ll. 34). It would have been obvious to one of ordinary skill in the art at the time the invention was made to bond the Cu balls disclosed by Koning using Cu-Sn intermetallic compounds in a ratio ($\text{Cu}_6\text{Sn}_5/\text{Cu}_3\text{Sn}_6$) of less than 0.65 in order to improve the electric and heat resistance properties of the alloy as taught by lino.

7. Regarding claim 28, lino discloses that the Cu-Sn compound may include Cu_3Sn (col. 2/lls. 15-17).

8. Regarding claim 30, Koning in view of lino discloses that the Cu_3Sn_6 has a thickness of about a few micrometers. Note that any thickness can be expressed in micrometers. In this case, any thickness that is smaller than the overall thickness of the solder ball 102 is considered to be about a few micrometers.

9. Regarding claims 31 and 35, Koning in view of lino does not disclose the specific method used to make the Cu_3Sn_6 . However, a "product by process" claim is directed to the product per se, no matter how actually made. See In re Thorpe et al., 227 USPQ 964 (CAFC, 1985) and the related case law cited therein which makes it clear that it is the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that, as here, an old or obvious product produced by a new method

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is not patentable as a product, whether claimed in "product by process" claims or not. As stated in *Thorpe*, even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935). Note that Applicant has burden of proof in such cases as the above case law makes clear. In the instant case, the method for forming the Cu₆Sn such as reflowing a Cu balls, and Sn base solder at a temperature higher than a melting point of the Sn base solder and lower than a melting point of the Cu balls is an intermediate process step that does not affect the structure of the final device because the physical and chemical properties of an intermetallic compound are not altered by its method of fabrication. It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the Cu₃Sn₆ by reflowing a Cu balls, and Sn base solder at a temperature higher than a melting point of the Sn base solder and lower than a melting point of the Cu balls or by any other suitable method known in the art since the physical and chemical properties of an intermetallic are not altered by its method of fabrication and because a "product by process" claim is directed to the product per se, no matter how actually made as taught by In re Thorpe et al.

10. Claims 32 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koning (US 6,365,973 cited by applicant) in view of lino et al.

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(US 6,207, 259) as applied to claims 27 and ~~33~~ above, and further in view of Borenstein et al. (US 5,178,685).

11. Regarding claims 32 and 36, Koning in view of lino does disclose the use of a Sn base solder that comprises an eutectic Sn-Cu solder, Sn-Cu solder to which at least one of In, Zn, and Bi is added; eutectic Sn-Ag solder; eutectic Sn-Ag solder to which at least one of In, Zn and Bi is added; eutectic Sn-Ag-Cu solder, or eutectic Sn-Ag-Cu solder to which at least one of In, Zn, and Bi is added. Nevertheless, Borenstein discloses the use of a Sn-Ag eutectic solder having 96% Sn and 4% Ag improve the thermal aging resistance of the element. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use an eutectic a Sn-Ag eutectic solder having 96% Sn and 4% Ag in order to improve the thermal aging resistance of the solder ball disclosed by Koning in view of lino (col. 4/lis. 65-64).

Allowable Subject Matter

12. Claims 29, 33 and 37 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

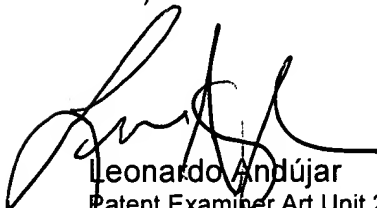
Conclusion

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Leonardo Andújar whose telephone number is 571-272-1912. The examiner can normally be reached on Mon through Thu from 9:00 AM to 7:30 PM EST.

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14. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J. Flynn can be reached on 571-272-1915. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

15. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Leonardo Andújar
Patent Examiner Art Unit 2826
09/12/2004